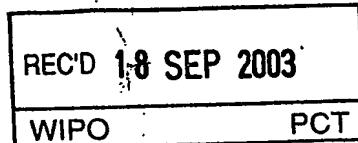


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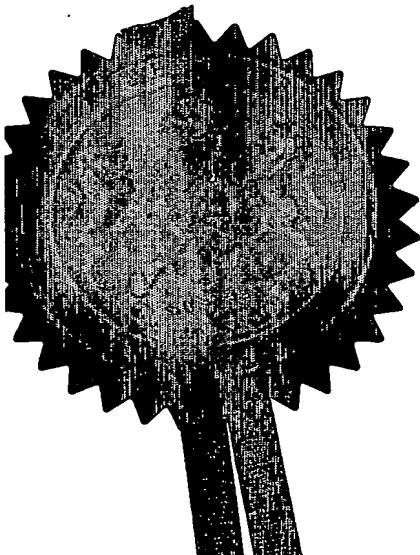
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1. Your reference

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2. Patent application number

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3. Full name, address and postcode of the or of each applicant (underline all surnames)

DOW CORNING CORPORATION  
Midland P.O. Box 9914  
Michigan 48611 Intellectual Property - C01232  
USA 2200 W Salzburg Road.  
414029005 ✓ Midland MI 48686-0944.

Patents ADP number (if you know it)

USA/Michigan

08506010001

4. Title of the invention

SILICONE FOAM CONTROL COMPOSITIONS

5. Name of your agent (if you have one)

"Address for service" in the United Kingdom to which all correspondence should be sent (including the postcode)

P V Davies  
DOW CORNING LIMITED  
Intellectual Property Department  
Cardiff Road  
Barry  
CF63 2YL

7804594002

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SILICONE FOAM CONTROL COMPOSITIONS

## FIELD OF THE INVENTION

5 [0001] This invention is concerned with silicone-based foam control compositions for use in aqueous compositions which are liable to foam. The foam control compositions of the invention can be added to detergent compositions, particularly detergent powders, to inhibit excessive foaming when the detergent is used in washing.

10 [0002] In many aqueous systems which are used e.g. in food processes, textile dyeing, paper production, sewage treatment and cleaning applications, the production of foam needs to be controlled or prevented. It is important to keep the foam formation to an acceptable level when laundering is performed in automatic washing machines, especially front loading machines. Excessive foam would cause overflow of the washing liquor onto the floor as well

15 as reduction in the efficiency of the laundering operation itself. There is a move in the detergent industry towards the use of detergent compositions which will perform to a higher efficiency than hitherto. There is a need to control foam from e.g. increased surfactant levels in the detergent compositions, use of surfactants which have a higher foam profile than traditional surfactants and changing laundering conditions. It is desirable to keep the addition

20 level of foam control compositions to a minimum. There has therefore arisen a need to develop more efficient foam control compositions for incorporation into detergent compositions.

## BACKGROUND TO THE INVENTION

25 [0003] EP-A-1075683 describes a foam control agent comprising (A) an organopolysiloxane material having at least one silicon-bonded substituent of the formula X-Ph, wherein X denotes a divalent aliphatic hydrocarbon group and Ph denotes an aromatic group, (B) a water-insoluble organic liquid, (C) an organosilicon resin and (D) a hydrophobic

30 filler. The water-insoluble organic liquid (B) can for example be a mineral oil, liquid polyisobutene, isoparaffinic oil or vegetable oil. EP-A-1075684 describes a foam control agent of similar composition except that it does not contain water-insoluble organic liquid (B).

[0004] EP-A-578424 describes a foam control agent which contains an polydiorganosiloxane with alkyl side chains in which each alkyl side chain contains from 9 to 35 carbon atoms. The polydiorganosiloxane is used together with a finely divided 5 hydrophobic particulate material, for example, hydrophobic silica, and optionally an MQ organosilicon resin. EP-A-1070526 describes such a foam control composition additionally comprising a stabilizing aid which is an organic compound having a melting point of from about 40 to 80°C, preferably a fatty acid, a fatty alcohol or an alkylphosphoric acid.

10 [0005] EP-A-210731 describes a particulate foam control agent comprising a silicone antifoam and an organic material having a melting point in the range 50-85°C which comprises a monoester of glycerol and a 12-20C fatty acid, for example glyceryl monostearate, optionally in self-emulsifying form. The glyceryl monostearate is said not to affect the effectiveness of the silicone antifoam when it is released into the washing liquor.

15 [0006] GB-A-1523957 describes a foam control substance which comprises powdered or granular sodium tripolyphosphate, sodium sulphate or sodium perborate having on the surface thereof an organopolysiloxane antifoam agent which is at least partially enclosed within a mixture of a water insoluble wax having a melting point of 55-100°C and a water 20 insoluble emulsifying agent.

[0007] US-A-4609490 describes a defoaming agent for bean curd manufacture which comprises not less than 90% glycerol fatty acid monoester with additives comprising a silicone which has defoaming activity and an inorganic substance such as calcium carbonate 25 which has weak defoaming activity and can serve as a carrier.

30 [0008] There is still a need to provide more efficient foam control agents. We have now surprisingly found that if efficient foam control agents based on organopolysiloxane materials are combined with certain combinations of additives, an even more efficient foam control composition can be obtained.

## SUMMARY OF THE INVENTION

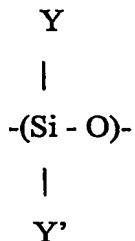
[0009] A foam control composition according to the present invention comprises a polysiloxane fluid and an additive composition comprising 5-95 parts by weight of a non-polar component (A) and 5-95 parts by weight of a component (B) which is miscible with component (A) and is more polar than component (A), at least one of (A) and (B) being miscible with the polysiloxane fluid.

[0010] By 'miscible', we mean that materials in the liquid phase (i.e., molten if necessary) mixed in the proportions in which they are present in the foam control composition do not show phase separation. This can be judged by the clarity of the liquid mixture in the absence of any filler or resin. If the liquids are miscible the mixture is clear and remains as one phase. If the liquids are immiscible the mixture is opaque and separates into two phases upon standing.

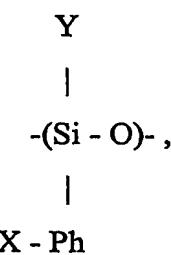
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## DETAILED DESCRIPTION OF THE INVENTION

[0011] The polysiloxane fluid can for example be a polysiloxane comprising at least 50% diorganosiloxane units of the formula



25 and up to 50% diorganosiloxane units of the formula

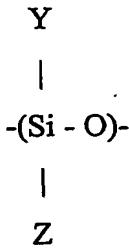


wherein X denotes a divalent aliphatic organic group bonded to silicon through a carbon atom; Ph denotes an aromatic group; Y denotes an alkyl group having 1 to 4 carbon atoms;

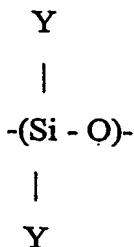
and Y' denotes an aliphatic hydrocarbon group having 1 to 24 carbon atoms, as described in EP1075684. The diorganosiloxane units containing a -X-Ph group preferably comprise 5 to 40%, of the diorganosiloxane units in the fluid. The group X is preferably a divalent alkylene group having from 2 to 10 carbon atoms, most preferably 2 to 4 carbon atoms, but can 5 alternatively contain an ether linkage between two alkylene groups or between an alkylene group and -Ph, or can contain an ester linkage. Ph is most preferably a phenyl group, but may be substituted for example by one or more methyl, methoxy, hydroxy or chloro group, or two substituents R may together form a divalent alkylene group, or may together form an aromatic ring, resulting in conjunction with the Ph group in e.g. a naphthalene group. A 10 particularly preferred X-Ph group is 2-phenylpropyl -CH<sub>2</sub>-CH(CH<sub>3</sub>)-C<sub>6</sub>H<sub>5</sub>. The group Y' preferably has 1 to 6 carbon atoms, for example ethyl, methyl, propyl, isobutyl or hexyl. Mixtures of alkyl groups Y' can be used. Other groups may be present, for example haloalkyl groups such as chloropropyl, acyloxyalkyl or alkoxyalkyl groups or aromatic groups such as phenyl bonded direct to Si.

15 [0012] The polysiloxane fluid containing -X-Ph groups may be a substantially linear siloxane polymer or may have some branching, for example branching in the siloxane chain by the presence of some tri-functional siloxane units, or branching by a multivalent, e.g. divalent or trivalent, organic or silicon-organic moiety linking polymer chains, as described in 20 EP-A-1075684.

[0013] The polysiloxane fluid can alternatively be a polysiloxane comprising 50-100% diorganosiloxane units of the formula



25 30 wherein Y denotes an alkyl group having 1 to 4 carbon atoms, preferably methyl or ethyl, and Z denotes an alkyl group having 6 to 16, preferably 6-12 carbon atoms, for example octyl, hexyl, heptyl or decyl. Such a polysiloxane fluid can optionally contain up to 50% diorganosiloxane units of the formula



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[0014] It is preferred that the number of siloxane units (DP or degree of polymerisation) in the average molecule of the polysiloxane fluid of either of the above types is at least 5, more preferably from 10 to 5000. Particularly preferred are polysiloxanes with a 10 DP of from 20 to 1000, more preferably 20 to 200. The end groups of the polysiloxane can be any of those conventionally present in siloxanes, for example trimethylsilyl end groups.

[0015] The polysiloxane fluid containing -X-Ph groups, or the polysiloxane fluid containing -Z groups, is preferably present as at least 80% by weight of the polysiloxane fluid 15 content of the foam control composition, most preferably as 100% or more than 95% of the polysiloxane fluid. The polysiloxane fluid containing -X-Ph groups, or the polysiloxane fluid containing -Z groups, can contain polydimethylsiloxane or another known silicone antifoam fluid, preferably at less than 20%, most preferably less than 5%, by weight of total polysiloxane fluid.

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[0016] The polysiloxane fluid can alternatively be a polydiorganosiloxane in which the organic groups are substantially all alkyl groups having 1 to 4 carbon atoms, for example polydimethylsiloxane (PDMS) such as the branched PDMS produced by the process of EP-A-217501, or the process of US-A-5674938, or the process of US-A-6150488, or the process of 25 JP-A-2000-246009. Such PDMS fluids are however not preferred, since foam control agents based on them are less efficient in controlling foaming from modern detergent powders than those described in EP-A-1075684, and we have further found that the improvement in efficiency which can be imparted by a combination of additives according to the present invention is less marked for PDMS-based foam control agents.

30

[0017] The non-polar component (A) of the additive composition is preferably miscible with the polysiloxane fluid and is preferably a polyol ester (A) most preferably a polyol substantially fully esterified by carboxylate groups each having 7 to 36 carbon atoms.

● The polyol ester is preferably a glycerol triester or an ester of a higher polyol such as pentaerythritol or sorbitol, but can be a diester of a glycol such as ethylene glycol or propylene glycol, preferably with a fatty acid having at least 16 carbon atoms, for example ethylene glycol distearate. Examples of preferred glycerol triesters are glycerol tristearate, 5 glycerol tripalmitate and glycerol triesters of saturated carboxylic acids having 20 or 22 carbon atoms such as the material sold under the Trade Mark 'Synchrowax HRC'. Most preferably the polyol ester (A) is substantially fully esterified by carboxylate groups each having 14 to 22 carbon atoms. By "substantially fully esterified" we mean that for a diol such as ethylene glycol or a triol such as glycerol, at least 90% and preferably at least 95% of the 10 hydroxyl groups of the polyol are esterified. Higher polyols, particularly those such as pentaerythritol which show steric hindrance, may be "substantially fully esterified" when at least 70 or 75% of the hydroxyl groups of the polyol are esterified; for example pentaerythritol tristearate has the effect of a fully esterified polyol ester (A).

15 [0018] The non-polar component (A) can alternatively be an ether, for example an ether of a long chain alcohol having 12 to 24 carbon atoms such as stearyl alcohol, or can alternatively be a paraffin. The non-polar component (A) preferably has a melting point of at least 25°C, more preferably at least 35°C, and most preferably a melting point in the range 45-100°C. The component (A) can comprise two or more materials, for example glyceryl 20 tristearate and glyceryl tripalmitate, or glyceryl tristearate and Synchrowax HRC, or ethylene glycol distearate and Synchrowax HRC, can be used together with component (B) in the additive composition. Foam control compositions containing mixtures of two components (A) with component (B) in the additive composition may give even greater foam control efficiency

25 [0019] The component (A) is preferably a material which acts as a thickener for the polysiloxane fluid. More preferably, it has sufficient thickening properties that a 5% by weight solution of component (A) in the polysiloxane fluid has a viscosity at least double, most preferably at least three times, the viscosity of the polysiloxane fluid alone measured 30 using a Brookfield viscometer at 1 rpm. For example a 5% solution of glyceryl tristearate in a methyl ethyl 2-phenylpropyl polydiorganosiloxane of viscosity 3440 mPa.s has a viscosity at 25°C of 27300 mPa.s, and a 5% solution of Synchrowax HRC in the same fluid has a viscosity of 12500 mPa.s.

[0020] The more polar component (B) of the additive composition usually contains groups more polar than the groups present in non-polar component (A), for example more polar than the carboxylate ester groups in a polyol ester (A). The more polar group preferably 5 contains an active hydrogen atom, that is one liable to undergo hydrogen bonding. Examples of more polar groups are unesterified -OH groups (alcohol or phenol groups), unesterified -COOH groups, amide groups or amino groups. The more polar component (B) preferably has a melting point of at least 25°C, more preferably at least 35°C, and most preferably a melting point in the range 45-110°C. Either of (A) and (B) may have a melting point below 25°C but 10 the mixture of (A) and (B) preferably has a melting point of at least 25°C.

[0021] Examples of components (B) containing alcohol groups include long chain primary, secondary or tertiary alcohols including fatty alcohols, ethoxylated fatty alcohols, ethoxylated fatty acids, ethoxylated alkyl phenols and partial esters of polyols. The alcohols 15 preferably contain 8 to 22 carbon atoms such as lauryl alcohol, a branched C12 alcohol sold under the Trade Mark Isofol 12 believed to comprise 2-butyloctanol, a branched C20 alcohol sold under the Trade Mark Isofol 20 believed to comprise 2-octyldodecanol, or stearyl alcohol or oleyl alcohol. The ethoxylated fatty alcohols preferably contain 1 to 10 oxyethylene units and the alkyl group of the fatty alcohol preferably contains 16 to 24 carbon atoms, for 20 example "Volpo S2" (Trade Mark) which is an ethoxylated stearyl alcohol containing an average of 2 oxyethylene units per molecule, or a hydrogenated tallow alcohol ethoxylate. The ethoxylated fatty acids preferably contain 1 to 10 oxyethylene units and the alkyl group of the fatty acid preferably contains 14 to 24 carbon atoms, for example "Volpo CS5" (Trade 25 Mark) which is an ethoxylated mixture of palmitic and stearic acids having an average of 5 oxyethylene units per molecule. The ethoxylated alkyl phenols preferably contain 1 to 10 oxyethylene units and the alkyl group attached to the phenol nucleus preferably contains 6 to 12 carbon atoms, for example ethoxylated octylphenol or ethoxylated nonylphenol.

[0022] Partial esters of polyols useful as component (B) include monoesters or 30 diesters of glycerol and a carboxylic acid having 8 to 30 carbon atoms, for example glycerol monostearate, glycerol monolaurate or glycerol distearate. Mixtures of monoesters and diesters of glycerol can be used. Partial esters of other polyols are also useful, for example

propylene glycol monopalmitate, sorbitan monostearate, sorbitan monooleate or ethylene glycol monostearate.

[0023] Examples of components (B) containing phenol groups are alkyl phenols 5 preferably containing 6 to 12 carbon atoms in the alkyl group attached to the phenol nucleus, for example octylphenol or nonylphenol.

[0024] Examples of components (B) containing unesterified -COOH groups are fatty acids having 8 to 36 carbon atoms, for example stearic acid or palmitic acid. Examples of 10 components (B) containing amide groups are monoamides of fatty acids having 12 to 36 carbon atoms, for example stearamide or the amides sold under the Trade Mark 'Crodamide SR', 'Crodamide ER' and 'Crodamide BR' (believed to be the amide of a C22 fatty acid). Examples of components (B) containing amino groups are alkyl amines having 8 to 30 carbon atoms such as 1-octylamine and 1-dodecylamine.

[0025] More than one component (B) can be used, for example a mixture of a glyceryl monocarboxylate and a glyceryl dicarboxylate or a mixture of either of these with an 15 optionally ethoxylated fatty alcohol. The more polar component (B) is miscible with non-polar component (A) and may or may not be miscible with the polysiloxane fluid. The components (B) listed above containing amide groups are generally not soluble in the 20 polysiloxane fluid. The alkylphenols are generally miscible with the polysiloxane fluid. The linear or branched long chain alkanols such as dodecanol, 2-butyloctanol and 2-octyldodecanol are generally miscible with the polysiloxane fluid, but the ethoxylated 25 alcohols generally are not. The component (B) should be miscible with or stably dispersed in the mixture of polysiloxane fluid and non-polar component (A).

[0026] The proportions of the non-polar component (A) and the more polar 30 component (B) can vary widely within the range 5-95 parts by weight of component (A) and 5-95 parts by weight of a component (B). For most combinations of (A) and (B) there is an optimum proportion for maximum foam control efficiency. For example, when component (A) is a fully esterified polyol such as a glycerol triester and component (B) contains unesterified alcohol groups, particularly when (B) is a partially esterified polyol, the ratio of (A) to (B) is preferably in the range 10:90 to 50:50 by weight, most preferably 15:85 to 30:70.

The additive composition can for example comprise 10-50 parts by weight glycerol tristearate and 50-90 parts by weight glycerol monostearate. On the other hand, when the component (B) is an alkylphenol, the ratio of (A) to (B) is preferably in the range 50:50 to 95:5 by weight, most preferably 60:40 to 90:10.

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[0027] The additive composition comprising (A) and (B) preferably has a melting point of at least 25°C, most preferably at least 35°C. The additive composition is preferably present in the foam control composition at 10-200% by weight based on the polysiloxane fluid, most preferably 20 up to 100 or 120%.

10

[0028] The foam control composition preferably contains a hydrophobic filler dispersed in the polysiloxane fluid. Hydrophobic fillers for foam control agents are well known and are particulate materials which are solid at 100°C such as silica, preferably with a surface area as measured by BET measurement of at least 50 m<sup>2</sup>/g., titania, ground quartz, 15 alumina, an aluminosilicate, an organic wax, e.g. polyethylene wax or microcrystalline wax, zinc oxide, magnesium oxide, a salt of an aliphatic carboxylic acids, a reaction product of an isocyanate with an amine, e.g. cyclohexylamine, or an high melting (above 100°C) alkyl amide such as ethylenebisstearamide or methylenebisstearamide. Mixtures of two or more of these can be used.

20

[0029] Some of the fillers mentioned above are not hydrophobic in nature, but can be used if made hydrophobic. This could be done either in situ (i.e. when dispersed in the polysiloxane fluid), or by pre-treatment of the filler prior to mixing with the polysiloxane fluid. A preferred filler is silica which is made hydrophobic. Preferred silica materials are 25 those which are prepared by heating, e.g. fumed silica, or precipitation. The silica filler may for example have an average particle size of 0.5 to 50 µm, preferably 2 to 30 and most preferably 5 to 25 µm. It can be made hydrophobic by treatment with a fatty acid, but is preferably done by the use of methyl substituted organosilicon materials such as dimethylsiloxane polymers which are end-blocked with silanol or silicon-bonded alkoxy groups, hexamethyldisilazane, hexamethyldisiloxane or organosilicon resins containing (CH<sub>3</sub>)<sub>3</sub>SiO<sub>1/2</sub> groups. Hydrophobing is generally carried out at a temperature of at least 100°C. Mixtures of fillers can be used, for example a highly hydrophobic silica filler such as

that sold under the Trade Mark 'Sipernat D10' can be used together with a partially hydrophobic silica such as that sold under the Trade Mark 'Aerosil R972'.

[0030] The amount of hydrophobic filler in the foam control composition of the 5 invention is preferably 0.5-50% by weight based on the polysiloxane fluid, more preferably from 1 up to 10 or 15% and most preferably 2 to 8%.

[0031] The foam control composition preferably contains an organosilicon resin 10 which is associated with the polysiloxane fluid. Such an organosilicon resin can enhance the foam control efficiency of the polysiloxane fluid. This is particularly true for polysiloxane fluids containing -X-Ph groups, as described in EP-A-1075684, and is also true for polysiloxane fluids containing -Z groups. In such polysiloxane fluids, the resin modifies the 15 surface properties of the fluid. The additive composition comprising (A) and (B) is particularly effective when used in foam control compositions containing an organosilicon resin, and can markedly improve the foam control efficiency even from the highly efficient 20 foam control agents described in EP-A-1075684.

[0032] The organosilicon resin is generally a non-linear siloxane resin and preferably 25 consists of siloxane units of the formula  $R'_{a}SiO_{4-a/2}$  wherein  $R'$  denotes a hydroxyl, hydrocarbon or hydrocarbonoxy group, and wherein  $a$  has an average value of from 0.5 to 2.4. It preferably consists of monovalent trihydrocarbonsiloxyl (M) groups of the formula  $R''_3SiO_{1/2}$  and tetrafunctional (Q) groups  $SiO_{4/2}$  wherein  $R''$  denotes a monovalent 30 hydrocarbon group. The number ratio of M groups to Q groups is preferably in the range 0.4:1 to 2.5:1 (equivalent to a value of  $a$  in the formula  $R'_{a}SiO_{4-a/2}$  of 0.86 to 2.15), more preferably 0.4:1 to 1.1:1 and most preferably 0.5:1 to 0.8:1 (equivalent to  $a=1.0$  to  $a=1.33$ ). The organosilicon resin (C) is preferably a solid at room temperature. The molecular weight of the resin can be increased by condensation, for example by heating in the presence of a base. The base can for example be an aqueous or alcoholic solution of potassium hydroxide or sodium hydroxide, e.g. a solution in methanol or propanol. A resin comprising M groups, trivalent  $R''SiO_{3/2}$  (T) units and Q units can alternatively be used, or up to 20% of units in the 35 organosilicon resin can be divalent units  $R''_2SiO_{2/2}$ . The group  $R''$  is preferably an alkyl group having 1 to 6 carbon atoms, for example methyl or ethyl, or can be phenyl. It is particularly preferred that at least 80%, most preferably substantially all,  $R''$  groups present

are methyl groups. The resin may be a trimethyl-capped resin. Other hydrocarbon groups may also be present, e.g. alkenyl groups present for example as dimethylvinylsilyl units, most preferably not exceeding 5% of all R" groups. Silicon bonded hydroxyl groups and/or alkoxy, e.g. methoxy, groups may also be present.

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[0033] The organosilicon resin is preferably present in the antifoam at 1-50% by weight based on the polysiloxane fluid, particularly 2-30% and most preferably 4-15%. The organosilicon resin may be soluble or insoluble in the polysiloxane fluid. If the resin is insoluble in the polysiloxane fluid, the average particle size of the resin may for example be 10 from 0.5 to 400 $\mu$ m, preferably 2 to 50 $\mu$ m. The resin (C) can alternatively be added into the foam control agent in the form of solid particles, for example spray dried particles.

[0034] The foam control composition of the invention can additionally contain a hydrophobic organic liquid as an auxiliary foam control agent, for example a mineral oil, 15 especially hydrogenated mineral oil or white oil, liquid polyisobutene, an isoparaffinic oil or petroleum jelly. The weight ratio of organopolysiloxane fluid to hydrophobic organic liquid can for example be 100/0 to 10/90, preferably 70/30 to 20/80.

[0035] The foam control compositions according to the invention may be made by 20 combining the polysiloxane fluid and the non-polar component (A) and the more polar component (B) of the additive composition, and the hydrophobic filler and/or the organosilicon resin if used, in any convenient way. The polysiloxane fluid, the hydrophobic filler and the organosilicon resin if used are preferably mixed together under shear. Where 25 the filler needs to be made hydrophobic in situ, the manufacturing process includes a heating stage, preferably under reduced pressure, in which the filler and the treating agent are mixed together in part or all of polysiloxane fluid, in the presence of a suitable catalyst if required. The components (A) and/or (B) can be premixed with the fluid before mixing with the filler and resin, or (A) and (B) can be subsequently mixed, together or separately, with the foam control agent comprising fluid, filler and resin.

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[0036] The foam control composition of the present invention is preferably supported on a particulate carrier, particularly when the composition is to be used in a powdered product such as a detergent powder. Examples of carriers and/or supports are zeolites, for example

Zeolite A or Zeolite X, other aluminosilicates or silicates, for example magnesium silicate, phosphates, for example powdered or granular sodium tripolyphosphate, sodium sulphate, sodium carbonate, sodium perborate, a cellulose derivative such as sodium carboxymethylcellulose, granulated starch, clay, sodium citrate, sodium acetate, sodium bicarbonate and native starch. We have found that in addition to improving foam control efficiency, the additives comprising triglycerides and other polyol esters improve the stability of the foam control granules, especially granules based on a sodium carbonate carrier.

[0037] Each of the components (A) and (B) can be mixed with the foam control agent comprising fluid and optionally filler and/or resin before being deposited on the carrier. Most preferably, the polysiloxane fluid containing the hydrophobic filler and optionally the organosilicon resin is mixed with the additive composition and the mixture is deposited on the carrier particles in non-aqueous liquid form. The mixture is preferably deposited on the carrier particles at a temperature at which the additive composition is liquid, for example a temperature in the range 40-100°C. Alternatively, the polysiloxane fluid, the hydrophobic filler, the organosilicon resin if present and the additive composition are emulsified in water and the resulting aqueous emulsion is deposited on the carrier particles. The supported foam control composition is preferably made by an agglomeration process in which the foam control composition is sprayed onto the carrier particles while agitating the particles. The particles are preferably agitated in a high shear mixer through which the particles pass continuously. In one preferred process, the particles are agitated in a vertical, continuous high shear mixer in which the foam control composition is sprayed onto the particles. One example of such a mixer is a Flexomix mixer supplied by Hosokawa Schugi.

[0038] The supported foam control composition may additionally include a water-soluble or water-dispersible binder to improve the stability of the particles. Many of the components (A) and (B) of the additive composition according to the invention act as binders to some extent but a further binder can be added to provide extra handling stability if required. Examples of binders are polycarboxylates, for example polyacrylic acid or a partial sodium salt thereof or a copolymer of acrylic acid, for example a copolymer with maleic anhydride, polyoxyalkylene polymers such as polyethylene glycol, which can be applied molten or as an aqueous solution and spray dried, reaction products of tallow alcohol and ethylene oxide, or polypropylene glycol, cellulose ethers, particularly water-soluble or water-

swellable cellulose ethers such as sodium carboxymethylcellulose, or sugar syrup binders such as Polysorb 70/12/12 or LYCASIN 80/55 HD $\ddot{S}$  maltitol syrup or Roclys C1967 S maltodextrin solution. The water-soluble or water-dispersible binder can be mixed with the foam control composition before being deposited on the carrier, but preferably is separately deposited on the carrier particles. In one preferred procedure the foam control composition is deposited on the carrier particles as a non-aqueous liquid at a temperature in the range 40-100°C and the water-soluble or water-dispersible binder is at the same time or subsequently deposited on the carrier from a separate feed as an aqueous solution or dispersion.

10 [0039] The supported foam control composition may optionally contain a surfactant to aid dispersion of the foam control composition in the binder and/or to help in controlling the "foam profile", that is in ensuring that some foam is visible throughout the wash without overfoaming. Examples of surfactants include silicone glycols, or fatty alcohol ether sulphate or linear alkylbenzene sulphonate may be preferred with a polyacrylic acid binder. The 15 surfactant can be added to the foam control composition undiluted before the silicone is deposited on the carrier, or the surfactant can be added to the binder and deposited as an aqueous emulsion on the carrier.

20 [0040] The foam control composition can alternatively be provided in the form of an oil-in-water emulsion using any of the surfactants described in EP-A-1075684. Alternatively the foam control agent can be provided as a water-dispersible composition in a water-dispersible vehicle such as a silicone glycol or in another water-miscible liquid such as ethylene glycol, propylene glycol, polypropylene glycol, polyethylene glycol, a copolymer of ethylene glycol and propylene glycol, an alkyl polyglycoside, an alcohol alkoxylate or an 25 alkylphenol alkoxylate.

30 [0041] The foam control compositions of the invention can contain additional ingredients such as a density adjuster, a colour preservative such as a maleate or fumarate, e.g. bis(2-methoxy-1-ethyl)maleate or diallyl maleate, an acetylenic alcohol, e.g. methyl butynol, cyclooctadiene, or cyclic methyl vinyl siloxane which reacts with any residual Pt catalyst present, a thickening agent such as carboxymethyl cellulose, polyvinyl alcohol or a hydrophilic or partially hydrophobed fumed silica, or a colouring agent such as a pigment or dye.

[0042] The foam control agents according to this invention are useful for reducing or preventing foam formation in aqueous systems, particularly foam generated by detergent compositions during laundering, and are particularly useful in detergent compositions which 5 have a high foaming characteristic, for example those based on high levels of anionic surfactants, e.g. sodium dodecyl benzene sulphonate to ensure effectiveness of detergent composition at lower washing temperatures, e.g. 40°C.

[0043] The following examples illustrate the invention. All parts and percentages are 10 expressed by weight unless otherwise stated. The foam control agents may also be employed in such processes as paper making and pulping processes, textile dyeing processes, cutting oil, coatings and other aqueous systems where surfactants may produce foam.

Examples 1 to 4

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[0044] 6% by weight treated precipitated silica (Sipernat® D10) and 1% R972 partially hydrophobic silica (both supplied by Degussa) were dispersed in 86.3% polysiloxane fluid having a degree of polymerisation of 60 and comprising 79 mole% methyl ethyl siloxane groups, 20 mole% methyl  $\alpha$ -methylstyrene siloxane groups and 1 mole% divinyl crosslinking groups. 6.7% by weight of a 60% by weight solution of an organosiloxane resin having trimethyl siloxane units and  $\text{SiO}_2$  units in a M/Q ratio of 0.65/1 in octyl stearate was 20 added. The mixture was homogenised through a high shear mixer to form a foam control compound FC1.

25 [0045] 13 parts by weight of the silicone foam control agent FC1 was mixed at 80°C with 7 parts of an additive composition comprising 'Synchrowax HRC' glyceryl triester and octylphenol (OP) in various ratios as shown in Table 1. The resulting liquid foam control composition was in each case sprayed onto 80 parts by weight of a starch powder carrier in a granulating mixer to produce a supported foam control composition.

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[0046] In comparative experiments C1 and C2, 7 parts by weight 'Synchrowax HRC' and octylphenol respectively were each mixed separately with 13 parts FC1 and sprayed onto 80 parts starch carrier to produce a supported foam control composition.

[0047] Example and comparative foam control agents were tested in a powder detergent formulation which comprised 327 parts by weight zeolite, 95 parts of a 55% aqueous solution of sodium dodecylbenzenesulphonate, 39 parts ethoxylated lauryl stearyl alcohol, 39 parts sodium sulphate, 125 parts sodium carbonate and 125 parts sodium perborate. Each foam control composition was used at a concentration of 0.1% by weight FC1 based on detergent composition except that of C2, which had reduced foam control efficiency and was used at 0.3%. The evaluation was made in a Miele 934 front loading washing machine, loaded with 16 cotton towels, 100g of the detergent formulation, 17 litres of water of 9 degree German hardness using a wash cycle of 42 minutes and 4 rinses R1 to R4 at 40°C. The foam height was measured every 5 minutes during the wash cycle and recorded, where the value indicated is the foam height in the washing machine, with 100% referring to the fact that the window of the machine was full of foam, 50%, that is was half full of foam. The results are described in Table 1 below.

15

#### Example 5

[0048] Example 2 was repeated using nonylphenol (NP) in place of octylphenol, and tested as for Examples 1 to 4. The results are described in Table 1.

20

Table 1

Example	Wt. Ratio HRC/OP	FC1 conc.	Foam height after ... minutes									
			5	10	15	20	25	30	35	40	42	
1	60/40	0.1%	0	0	0	0	0	0	0	5	10	
2	80/20	0.1%	0	0	0	0	0	0	0	10	10	
3	90/10	0.1%	0	0	0	0	0	5	10	10	15	
4	95/5	0.1%	0	0	0	0	5	10	20	30	30	
5	80/20 NP	0.1%	0	0	0	0	0	20	30	30	30	
C1	100/0	0.1%	5	30	40	50	60	65	75	80	85	
C2	0/100	0.3%	0	0	0	10	30	50	60	70	70	

[0049] The foam control agents containing additive compositions comprising octylphenol as well as HRC glycetyl triester showed markedly improved performance over compositions only containing HRC as additive, despite the poor effect of octylphenol used  
5 alone as additive.

#### Example 6

[0050] 4% by weight Sipermat® D10 and 1% by weight R972 partially hydrophobic  
10 silica were dispersed in 88.3% poly(methyl octyl siloxane) fluid having a degree of polymerisation of 60. 6.7% of the M/Q resin solution described in Example 1 was added. The mixture was homogenised through a high shear mixer to form a foam control compound FC2.

15 [0051] 13.5 parts by weight FC2 was mixed at 80°C with an additive composition comprising 5.6 parts 'Synchrowax HRC' and 1.4 parts dodecanol. The resulting liquid mixture was sprayed onto 79.5 parts by weight starch powder in a granulating mixer to produce a supported foam control composition.

20 [0052] The supported foam control composition was tested in a wash test as described in Examples 1 to 4 at a concentration of 0.1% by weight FC2 based on detergent composition. The maximum foam height recorded was 40.

#### Example 7

25 [0053] 15 parts by weight FC1 was mixed at 80°C with an additive composition comprising 8 parts glycetyl monostearate (GMS; 90% pure) and 8 parts glycetyl tristearate (GTS). The resulting liquid mixture was sprayed onto 69 parts by weight sodium carbonate powder in a granulating mixer to produce a supported foam control composition.

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#### Examples 8 to 13

[0054] Supported foam control compositions were produced as described in Example

7 using various proportions of GMS and GTS, as shown in Table 2.

**Example 14**

5 [0055] A supported foam control composition was produced as described in Example 7 using as the additive composition a mixture of 16% by weight GTS with 36% GMS and 48% glyceryl distearate (GDS).

**Example 15**

10 [0056] Example 7 was repeated using as the additive composition a mixture of equal weights of GTS and the additive composition of Example 14. The additive composition of Example 15 comprised 58% GTS, 18% GMS and 24% GDS.

**Example 16**

[0057] Example 10 was repeated using the fatty acid amide sold under the Trade Mark 'Crodamide OR' in place of GMS.

**Examples 17 to 19**

[0058] Example 14 was repeated using lower amounts of the GTS/GMS/GDS mixture while keeping the silicone antifoam level constant, as shown in Table 2.

**Example 20**

[0059] Example 14 was repeated using a zeolite carrier in place of the sodium carbonate carrier. The results are shown in Table 2.

**Comparative Examples C3 to C5**

[0060] Comparative Example C3 was produced by the process of Example 7 but using PEG 4000 polyethylene glycol binder in place of the additive mixture of GMS 90 and

GTS used in Example 7. Comparative Examples C4 and C5 were produced by the process of Example 7 but using GMS 90 alone (C4) or GTS alone (C5) in place of the additive mixture of GMS and GTS used in Example 7.

## 5 Comparative Tests

[0061] Example and comparative foam control agents were tested in a commercial powder detergent formulation based on anionic and nonionic surfactants. Each supported foam control composition was used at 0.5% by weight of the detergent powder (0.07% by weight FC1 based on detergent powder). The wash test procedure and assessment was as described in Examples 1 to 4. The results are listed in Table 2.

Table 2

Example	Carrier	Binder	Additive	Foam Control Compound	Foam height after....mins								
					Wash time								
					5	10	15	20	25	30	35	40	42
C3	70% Sodium carbonate	15% PEG 4000	None	15% FC1	20	40	50	60	80	90	10	10	100
C4	70.2% Sodium carbonate	None	14.4% GMS	15.4% FC1	0	0	20	40	50	60	80	10	100
C5	70.7% Sodium carbonate	None	14.9% GTS	14.4% FC1	60	60	50	70	70	80	90	90	100
7	69% Sodium carbonate	None	8% GMS + 8% GTS	15% FC1	50	40	40	40	40	60	60	70	70
8	69.6% Sodium Carbonate	None	GMS + 11.7% GTS	FC1									
9	69.2% Sodium carbonate	None	11.9% GMS + 4% GTS	14.9% FC1	40	10	20	20	30	40	60	60	70

Example	Carrier	Binder	Additive	Foam Control Compound	Foam height after....mins									
					Wash time									
					5	10	15	20	25	30	35	40	42	
10	70.5% Sodium carbonate	None	12.9% GMS + 2.3% GTS	14.3% FC1	0	0	0	10	10	20	30	40	40	
11	70.5% Sodium carbonate	None	13.3% GMS + 1.9% GTS	14.3% FC1	10	10	0	0	10	20	30	40	50	
12	70.6% Sodium carbonate	None	13.7% GMS + 1.5% GTS	14.2% FCI	10	30	20	10	20	40	50	50	60	
13	71.05% Sodium carbonate	None	14.1% GMS + 0.75% GTS	14.1% FC1	0	20	10	20	30	50	60	60	70	
14	70.7% Sodium carbonate	None	5.4% GMS + 7.2% GDS + 2.4% GTS	14.3% FC1	20	13	7	13	20	33	37	47	50	
15	71% Sodium carbonate	None	2.7% GMS + 3.6% GDS + 8.7% GTS	14% FC1	40	30	20	20	20	20	40	50	60	
16	70.45% Sodium carbonate	None	2.25 GTS + 12.9% Crodamide OR	14.4% FC1	0	10	20	30	40	60	60	70	70	
17	74.4% Sodium carbonate	None	4.1% GMS + 5.5% GDS + 1.9% GTS	14.1% FC1	10	20	0	0	10	40	40	40	50	
18	78.5% Sodium carbonate	None	2.7% GMS + 3.6% GDS + 1.2% GTS	14% FC1	0	0	10	10	10	20	30	40	50	

Example	Carrier	Binder	Additive	Foam Control Compound	Foam height after....mins								
					Wash time								
					5	10	15	20	25	30	35	40	42
19	80.6% Sodium carbonate	None	1.8% GMS + 2.4% GDS + 0.8% GTS	14.3 FC1	0	0	0	0	10	30	40	50	50
20	69.4% Zeolite	None	5.6% GMS + 7.6% GDS + 2.5% GTS	14.9% FC1	60	60	20	0	0	20	50	60	60

[0062] The improvement given by the additive compositions of the invention can be seen by comparing the maximum foam height for each of the Examples of the invention with the maximum foam height of 100% in each of the comparative experiments. The 5 comparative foam control compositions C3, C4 and C5 are themselves highly effective foam control agents, but the level of 0.07% by weight FC1 based on detergent powder is extremely low for a detergent with such a high surfactant content.

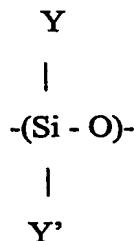
#### Example 21

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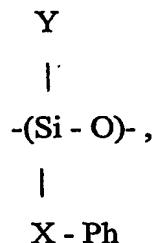
[0063] 13.88 parts by weight FC1 was mixed at 80°C with 6.46 parts Crodamide SR fatty acid amide and 1.13 parts glyceryl tristearate and was deposited on 78.53 parts starch granules. When wash tests were carried out using this supported foam control composition at 0.115% FC1 in the detergent composition described in Examples 7-16, no foam at all was 15 seen in a wash test at 40°C or in a wash test at 95°C. By comparison, when C3 was used at 0.115%, a maximum foam height of 70 was seen in the wash test at 40°C and a maximum foam height of 60 was seen in the wash test at 95°C.

CLAIMS

1. A foam control composition comprising a polysiloxane fluid and an additive composition comprising 5-95 parts by weight of a non-polar component (A) and 5-95 parts by weight of a component (B) which is miscible with component (A) and is more polar than component (A), at least one of (A) and (B) being miscible with the polysiloxane fluid.
2. A foam control composition according to Claim 1, characterized in that the polysiloxane fluid is a polysiloxane comprising at least 50% diorganosiloxane units of the formula

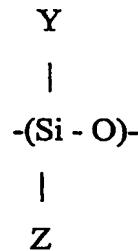


and up to 50% diorganosiloxane units of the formula

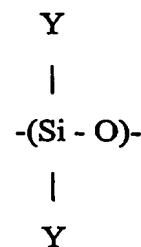


wherein X denotes a divalent aliphatic organic group bonded to silicon through a carbon atom; Ph denotes an aromatic group; Y denotes an alkyl group having 1 to 4 carbon atoms; and Y' denotes an aliphatic hydrocarbon group having 1 to 24 carbon atoms.

3. A foam control composition according to Claim 1, characterized in that the polysiloxane fluid is a polysiloxane comprising 50-100% diorganosiloxane units of the formula



and optionally up to 50% diorganosiloxane units of the formula



wherein Y denotes an alkyl group having 1 to 4 carbon atoms and Z denotes an alkyl group having 6 to 12 carbon atoms.

4. A foam control composition according to any of Claims 1 to 3, characterized in that the composition further contains an organosilicon resin.
5. A foam control composition according to claim 4, characterized in that the organosilicon resin is a siloxane resin consisting of monovalent trihydrocarbonsiloxy (M) groups of the formula  $R''_3SiO_{1/2}$  and tetrafunctional (Q) groups  $SiO_{4/2}$  wherein  $R''$  denotes an alkyl group and the number ratio of M groups to Q groups is in the range 0.4:1 to 1.1:1.
6. A foam control composition according to any of Claims 1 to 5, characterized in that the composition further contains a hydrophobic filler with an average particle size of from 0.5 to 30 $\mu$ m.
7. A foam control composition according to any of Claims 1 to 6, characterized in that the non-polar component (A) is a polyol ester which is a polyol substantially fully esterified by carboxylate groups each having 7 to 36 carbon atoms.

8. A foam control composition according to Claim 7, characterized in that the polyol ester (A) is a glycerol triester.
9. A foam control composition according to Claim 7 or Claim 8, characterized in that the polyol ester (A) is substantially fully esterified by carboxylate groups each having 14 to 22 carbon atoms.
10. A foam control composition according to any of Claims 7 to 9, characterized in that the component (B) contains groups more polar than the carboxylate ester groups of polyol ester (A) which are unesterified -OH groups.
11. A foam control composition according to Claim 10, characterized in that the component (B) is a glycerol mono- or di-ester of a carboxylic acid having 8 to 30 carbon atoms.
12. A foam control composition according to Claim 11, characterized in that the additive composition comprises 10-50 parts by weight glycerol tristearate and 50-90 parts by weight glycerol monostearate.
13. A foam control composition according to Claim 10, characterized in that the component (B) is an alkylphenol in which the alkyl group has 6 to 12 carbon atoms.
14. A foam control composition according to Claim 10, characterized in that the component (B) is an ethoxylated fatty alcohol which contains 1 to 10 oxyethylene units and in which the alkyl group of the fatty alcohol contains 14 to 24 carbon atoms.
15. A foam control composition according to any of Claims 7 to 9, characterized in that the component (B) contains groups more polar than the carboxylate ester groups of polyol ester (A) which are amide or amino groups.

16. A foam control composition according to any of Claims 1 to 15, characterized in that the additive composition has a melting point of at least 35°C.
17. A foam control composition according to any of Claims 1 to 16, characterized in that the additive composition is present at 20-200% by weight based on the polysiloxane fluid.
18. A granulated foam control agent comprising a foam control composition according to any of Claims 1 to 17 supported on a particulate carrier.
19. A granulated foam control agent according to Claim 18, characterized in that a water-soluble or water-dispersible binder is also deposited on the carrier particles.
20. A process for the production of a granulated foam control agent according to Claim 18 or Claim 19, characterized in that the polysiloxane fluid optionally containing hydrophobic filler and/or organosilicon resin is mixed with the additive composition and the mixture is deposited on the carrier particles in non-aqueous liquid form.
21. A process according to Claim 20, characterized in that the said mixture is deposited on the carrier particles at a temperature in the range 40-100°C.
22. A process according to Claim 20 or Claim 21, characterized in that a water-soluble or water-dispersible binder is separately deposited on the carrier particles.

PCT Application  
**EP0309159**

